We claim:

1. A variable area nozzle comprising:

a plurality of rotatable vanes; and,

each of said vanes interengages another of said vanes sealing said vanes.

2. A variable area nozzle as claimed in claim 1 wherein each of said vanes includes an interior surface and an exterior surface.

3. A variable area nozzle as claimed in claim 2 wherein each of said surfaces of said vanes includes a crowned contour.

4. A variable area nozzle as claimed in claim 3 wherein each of said vanes is rotatable with respect to a support.

5. A variable area nozzle as claimed in claim 3 further comprising a nozzle closer for rotating said vanes toward minimum cross-sectional opening.

6. A variable area nozzle as claimed in claim 5 wherein said nozzle closer is comprised of an SMA wire.

7. A variable area nozzle as claimed in claim 5 wherein said nozzle closer is comprised of a plurality of SMA wires.

8. A variable area nozzle as claimed in claim 5 wherein said nozzle closer comprises a hydraulic actuator.

9. A variable area nozzle as claimed in claim 8 wherein said nozzle closer comprises a plurality of hydraulic actuators.

10. A variable area nozzle as claimed in claim 5 wherein said nozzle closer

comprises a wire.

11. A variable area nozzle as claimed in claim 10 wherein said wire is metallic.

12. A variable area nozzle as claimed in claim 10 wherein said wire is synthetic.

13. A variable area nozzle as claimed in claim 6 wherein said nozzle closer further comprises nonconductive SMA standoffs for affixing said SMA wire within said vanes.

14. A variable area nozzle as claimed in claim 1 further comprising a nozzle opener.

15. A variable area nozzle as claimed in claim 12 wherein said nozzle opener is a spring.

16. A variable area nozzle as claimed in claim 13 wherein said nozzle opener is a leaf spring.

17. A variable area nozzle as claimed in claim 12 wherein said nozzle opener is a coil spring.

18. A variable area nozzle comprising:

a plurality of vanes;

each of said vanes includes a leading edge and a trailing edge;

each of said vanes includes an interior portion spaced apart from an exterior portion;

each of said vanes includes at least one tapered stiffener having a leading portion proximate to said leading edge and a trailing portion proximate to said trailing edge;

each leading edge of said tapered stiffeners being wider than said trailing portion;

said at least one tapered stiffener residing between said interior portion and said exterior portion of each of said vanes;

said interior portion of said vane affixed to said at least one tapered stiffener and said exterior portion of said vane affixed to said at least one tapered stiffener;

a spring opener residing between at least two of said vanes; and,

each of said vanes interengages another of said vanes sealing said vanes.

19. A variable area nozzle as claimed in claim 18 further comprising a closer.

20. A variable area nozzle as claimed in claim 19 wherein said closer is an SMA wire.

21. A variable area nozzle as claimed in claim 19 wherein said closer is a plurality of SMA wires forming an SMA rope.

22. A variable area nozzle as claimed in claim 20 wherein said SMA wire is nonconductively connected to at least two vanes.

23. A variable area nozzle as claimed in claim 21 wherein said SMA rope is nonconductively connected to at least two vanes.

24. A variable area nozzle as claimed in claim 20 further comprising an energy source, said energy source being applied to said SMA wire to heat said wire.

25. A variable area nozzle as claimed in claim 21 further comprising an energy source, said energy source being applied to said SMA rope to heat said rope.

26. A variable area nozzle as claimed in claim 19 wherein said at least one tapered stiffener includes walls and an aperture formed in said walls, and wherein said closer

comprises an SMA wire nonconductively affixed to said aperture.

27. A variable area nozzle as claimed in claim 18 wherein each of said vanes has a crowned contour.

28. A variable area nozzle as claimed in claim 18 wherein each of said vanes includes a tongue and a groove for interengaging a reciprocal tongue and groove of adjacent vanes.

29. A variable area nozzle comprising:

a circumferential support;

a plurality of circumferentially arranged vanes rotatably mounted to said circumferential support;

each of said vanes includes a male tongue portion and a female groove portion; and,

said male tongue portion of each of said vanes interengages said female groove portion of each adjacent vane.

30. A variable area nozzle as claimed in claim 29 wherein said vanes are contoured.

31. A variable area nozzle as claimed in claim 30 wherein said vanes are convexly contoured.

32. A variable area nozzle as claimed in claim 31 wherein said vanes rotate uniformly and concentrically.

33. A variable area nozzle as claimed in claim 29 wherein said male tongue

portion of said vanes seal against said female groove portions of said adjacent vanes.

34. A variable area nozzle comprising:

a concentric support;

a plurality of convexly contoured vanes circumferentially and rotatably mounted to said concentric support forming a nozzle infinitely positionable between a first position corresponding to a minimum area nozzle and a second position corresponding to a maximum area nozzle; and,

each of said plurality of convexly contoured vanes engages an adjacent vane sealing said nozzle in all positions between and including said first position corresponding to a minimum area nozzle and a second position corresponding to a maximum area nozzle.

35. A variable area nozzle as claimed in claim 34 in combination with a nacelle of a gas turbine.

36. A variable area nozzle as claimed in claim 34 in combination with a core of a gas turbine.

37. A variable area nozzle as claimed in claim 34 in combination with a hydraulic discharge line.

38. A variable area nozzle as claimed in claim 34 further comprising a closer.

39. A variable area nozzle as claimed in claim 34 further comprising an opener.

40. A variable area nozzle as claimed in claim 34 further comprising a rotary damper.

41. A variable area nozzle as claimed in claim 34 further comprising a rotational brake.

42. A variable area nozzle as claimed in claim 38 wherein said closer is an SMA wire.

43. A variable area nozzle as claimed in claim 38 wherein said closer is comprised of a plurality of SMA wires which form an SMA rope.

44. A variable area nozzle as claimed in claim 38 wherein said closer is a wire.

45. A variable area nozzle as claimed in claim 38 wherein said closer is comprised of a plurality of wires.

46. A variable area nozzle as claimed in claim 38 wherein said closer is a hydraulic actuator.

47. A variable area nozzle as claimed in claim 39 wherein said opener is a spring.

48. A variable area nozzle as claimed in claim 47 wherein said opener is a leaf spring.

49. A variable area nozzle as claimed in claim 47 wherein said opener is a coil spring.

50. A variable area nozzle as claimed in claim 40 wherein said rotary damper is a magneto-rheological fluid device.

51. A variable area nozzle as claimed in claim 40 wherein said rotational brake is a magneto-rheological brake.

52. A variable area nozzle comprising:

a concentric support; and,

a plurality of convexly contoured vanes circumferentially and rotatably mounted to said concentric support forming a nozzle infinitely positionable between a first position corresponding to a minimum area nozzle and a second position corresponding to a maximum area nozzle.

53. A variable area nozzle as claimed in claim 52 wherein each of said plurality of convexly contoured vanes includes a seal which engages an adjacent vane sealing said nozzle in all positions between and including said first position corresponding to a minimum area nozzle and a second position corresponding to a maximum area nozzle.

54. A variable area nozzle as claimed in claim 53 wherein said seal is a metal seal.

55. A variable area nozzle as claimed in claim 53 wherein said seal is labyrinth seal.

56. A variable area nozzle as claimed in claim 53 wherein said seal is a brush seal.

57. A variable area nozzle as claimed in claim 53 wherein said seal is a hydrostatic seal.

58. A variable area nozzle as claimed in claim 53 wherein said seal is an elastomeric seal.

59. A variable area nozzle as claimed in claim 52 wherein each of said plurality of convexly contoured vanes reside adjacent and interengage two of said vanes; and, wherein said vanes extend 360 degrees around said concentric support.

60. A variable area nozzle as claimed in claim 59 wherein said vanes include

longitudinal supports and wherein openers act between said supports of adjacent vanes.

61. A variable area nozzle as claimed in claim 59 wherein said vanes include longitudinal supports and wherein openers are positioned and act between vanes spaced 60 degrees apart.

62. A variable area nozzle as claimed in claim 61 wherein each of said vanes urge adjacent vanes to rotate concentrically about said concentric support.

63. A variable area nozzle as claimed in claim 52 wherein each of said convexly contoured vanes has a length, and, said lengths of said convexly contoured vanes varying from vane to vane.

64. A variable area nozzle as claimed in claim 63 wherein said vanes comprise a leading edge, a trailing edge, an inner surface, an outer surface, and an extender residing between said inner surface and said outer surface and being longitudinally and moveably extendable beyond said trailing edge.

65. A variable area nozzle as claimed in claim 52 wherein said plurality of vanes includes male vanes and female vanes adjacent said male vanes.

66. A variable area nozzle as claimed in claim 65 wherein said male and female vanes each include reciprocal tongues and grooves.

67. A variable area nozzle as claimed in claim 66 wherein said male and female vanes each include an interior and an exterior.

68. A variable area nozzle as claimed in claim 67 wherein: said interior of said male vanes includes a tongue; said interior of said female vanes includes a groove; said

exterior of said male vanes includes a groove and said exterior of said female vanes includes a tongue; said tongues of said interior of said male vane interengage said grooves of said interior of said female vanes; said tongues of said exterior of said female vanes interengage said grooves of said exterior of said male vanes; said male vanes include a main groove and a main tongue; said female vanes include a main groove and main tongue; and, said main tongues of said male and female vanes interengage said main grooves of said male and female vanes.

69. A variable area nozzle as claimed in claim 66 wherein said tongues and said grooves of said male and female vanes comprise a metal to metal seal.

70. A variable area nozzle as claimed in claim 66 wherein said tongues and said grooves of said male and female vanes comprise a labyrinth seal.

71. A variable area nozzle as claimed in claim 66 further comprising an elastomeric seal proximate each tongue and groove of each said male and female vanes.

72. A variable area nozzle as claimed in claim 66 further comprising a hydrostatic seal proximate each tongue and groove of each said male and female vanes.

73. A variable area nozzle as claimed in claim 66 further comprising a brush seal proximate each tongue and groove of each said male and female vanes.

74. A variable area nozzle comprising:

a concentric support;

a plurality of convexly contoured vanes;

each of said convexly contoured vanes has a length, said lengths of said convexly

contoured vanes being nonuniform; and,

said plurality of convexly contoured vanes circumferentially and rotatably mounted to said concentric support forming a nozzle infinitely positionable between a first position corresponding to a minimum area nozzle and a second position corresponding to a maximum area nozzle.

75. A variable area nozzle for use in a gas turbine engine comprising:

a concentric support;

a plurality of self sealing convexly contoured vanes circumferentially and rotatably mounted to said concentric support forming a nozzle infinitely positionable between a first position corresponding to a minimum area nozzle and a second position corresponding to a maximum area nozzle;

said convexly contoured vanes include a leading edge and a trailing edge;

two tapered stiffeners, said stiffeners being wider at said leading edge than at said trailing edge;

said convexly contoured vanes include an interior surface and an exterior surface both of which are affixed to said tapered stiffeners;

said interior and exterior surfaces of each of said convexly contoured vanes adapted to form interleaving tongues and grooves;

and, said interleaving tongues and grooves seal said nozzle in all positions between said first position corresponding to a minimum area nozzle and said second position corresponding to a maximum area nozzle.

76. A variable area nozzle for use in a gas turbine engine as claimed in claim 75 wherein said two tapered stiffeners are arranged as non parallel legs of a trapezoid.

77. A variable area nozzle for use in a gas turbine engine as claimed in claim 75 wherein said vanes alternately include grooves in said interior and exterior surfaces.

78. A variable area nozzle for use in a gas turbine engine as claimed in claim 77 wherein said grooves in said surfaces are generally arranged as non parallel legs of a trapezoid.

79. A variable area nozzle for use in a gas turbine engine as claimed in claim 75 wherein said concentric support is affixed to the nacelle.

80. A variable area nozzle for use in a gas turbine engine as claimed in claim 75 wherein said concentric support is affixed to the core engine.

81. A variable area nozzle for use in a gas turbine engine as claimed in claim 80 wherein said vanes are air cooled.

82. A vane for use in a variable area nozzle comprising:

said vane having a leading edge and a trailing edge;

an interior surface and an exterior surface affixed to said tapered support stiffeners; and,

said interior surface includes two grooves therein.

83. A vane for use in a variable area nozzle as claimed in claim 82 wherein said two grooves are arranged as non parallel legs of a trapezoid.

84. A vane for use in a variable area nozzle as claimed in claim 82 wherein said

tapered support stiffeners are arranged as non parallel legs of a trapezoid.

85. A vane for use in a variable area nozzle as claimed in claim 82 wherein each of said tapered stiffeners includes at least one aperture therein.

86. A vane for use in a variable area nozzle comprising:

said vane having a leading edge and a trailing edge;

an interior surface and an exterior surface affixed to said tapered support stiffeners; and,

said exterior surface includes two grooves therein.

87. A vane for use in a variable area nozzle as claimed in claim 86 wherein said two grooves are arranged as non parallel legs of a trapezoid.

88. A vane for use in a variable area nozzle as claimed in claim 86 wherein said tapered support stiffeners are arranged as non parallel legs of a trapezoid.

89. A vane for use in a variable area nozzle as claimed in claim 86 wherein each of said tapered stiffeners includes at least one aperture therein.

90. A variable area nozzle for use in a gas turbine engine comprising:

a support;

a plurality of interlaced vanes rotatably moveable with respect to said support forming an infinite number of frustum-shaped conic sections between an area of minimum cross section to an area of maximum cross section..

91. A variable area nozzle comprising:

a pivotable support;

a plurality of convexly contoured vanes circumferentially and rotatably mounted to said pivotable support forming a nozzle infinitely positionable between a first position corresponding to a minimum cross sectional area of said nozzle and a second position corresponding to a maximum cross sectional area of said nozzle; and,

said pivotable support enabling vectoring of said nozzle.

92. A process for controlling a variable area nozzle having interengaging convexly contoured vanes, a plurality of springs urging said vanes into an open-fail safe position, an SMA actuator urging said vanes into a closed position, utilizing a controller, a magneto-rheological brake and damper, and a rotary position sensor comprising the steps of:

comparing the actual position of said variable area nozzle with said desired position of said variable area nozzle;

generating an error signal;

outputting a signal to a heating device from said controller according to an algorithm;

heating a plurality of SMA wires;

outputting a locking signal to said magneto-rheological brake and damper; and,

positioning said variable area nozzle.

93. A variable area nozzle comprising:

a support;

a plurality of substantially trapezoidally shaped vanes circumferentially and

rotatably mounted to said support forming a nozzle infinitely positionable between a first position corresponding to a minimum area nozzle and a second position corresponding to a maximum area nozzle; and,

each of said plurality of said substantially trapezoidally shaped vanes engages an adjacent vane sealing said nozzle in all positions between and including said first position corresponding to a minimum area nozzle and a second position corresponding to a maximum area nozzle.